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AUTHOR Thompson, Fred
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ABSTRACT

Product-market planning is an inherently difficult practice. It aims at a match between consumer preference and institutional behavior. Unfortunately, consumer reactions to changes in institutional behavior are often highly uncertain. This paper assumes that institutional planners should neither ignore uncertainty nor seek to avoid all actions with uncertain outcomes. It is noted that institutional researchers need conceptual tools that will help them deal with situations where data are sparse and time is short. The key question that must be faced is: how much uncertainty is too much (or, how much information is enough)? Some simple, easily understood and easily used concepts are described that can increase the likelihood of getting good answers to this question. Experiences of Mitchell College in New Jersey are described. (Author/LBH)

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Robert H. Fenske
Arizona State University
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ABSTRACT

Product-market planning is an inherently difficult practice. It aims at a match between consumer preference and institutional behavior. Unfortunately, consumer reactions to changes in institutional behavior are more often than not highly uncertain. This paper assumes that institutional planners should neither ignore uncertainty nor seek to avoid all actions with uncertain outcomes.

This means that institutional researchers need conceptual tools that will help them deal with situations where data are sparse and time is short - where the key question that must be faced is: how much uncertainty is too much (or, how much information is enough)? This paper describes some simple, easily understood and easily used concepts that can increase the likelihood of getting good answers to this question.

THE COST AND VALUE OF MARKETING ANALYSIS

It is manifest that the planning orientation of many institutions must be drastically modified or these institutions may not survive. Institutional administrators can no longer afford to base resource allocations - course or program mix, faculty allocation, etc. - on vague notions of intradepartmental equity or campus balance. They can no longer afford to define institutional quality solely in terms of academic prestige. They can no longer afford to ignore public concerns about what is taught, how much is learned, and who is enrolled. Instead, resource allocation must take account of its effect on institutional revenue and quality must be redefined in terms of the benefits and costs as perceived by consumers of educational services.[1] To use the jargon of the business school, what this means is that institutional administrators must abandon their traditional product orientation and adopt a market orientation.

Such a shift in orientation represents a real opportunity for institutional researchers.[2] The basic tools of marketing are data based market research and market analysis. Market research is concerned with the identification of an organization's target markets, the size and intensity of demand in various market segments, the product attributes that are most salient to relevant consumer groups, the effects of competitive factors upon the demand for the organization's product line, and so forth. The provision of this kind of information is perfectly consistent with the kinds of research presently being conducted in most offices of institutional research.[3]

This opportunity, however, carries with it a grave responsibility. Marketing research is costly. The institutional researcher must know when and where not to seek additional information.[4] In this paper I shall attempt to show how the institutional researcher can use Bayesian statistics to place a value on marketing information and thereby provide answers to the following questions:

1) Should additional information be gathered before making a final decision on a course of action? If so, how much money should be spent?
2) How should alternative market research proposals be evaluated?
3) How should new information be combined with professional judgement in making decisions between alternate courses of action?

My plan is to describe a practical decision problem and then, with reference to this problem to address each of these questions in turn.

Mitchell University[5]

Mitchell, a small, well-respected residential university of 4,000 undergraduates and 3,000 graduate students, located in mid-New Jersey approximately equidistant from Philadelphia and New York, was considering the development of several continuing education programs. It was hoped that these programs would generate a net cash inflow, thereby making a contribution to the institution's fixed overheads. A preliminary analysis of the market indicated potential demand for programs in the following areas: business management, educational administration, music appreciation, painting and archeology.

Consequently, continuing education programs were proposed in each of these as follows: a residential management development program to run each year from September to June, a residency-optional educational administration program to run from June to September, and a non-residential, year-round evening program.

To evaluate this proposal a multi-year cash-flow forecast was requested. Operating costs, both fixed and variable, were estimated. Revenues, however, depended upon enrollment levels and these were recognized to be somewhat uncertain. Consequently, three forecasts were prepared based upon low, mean, and

high enrollment estimates. These possible outcomes (or states of nature) were assigned subjective probabilities of occurance of .25, .50, and .25 respectively. Table 1 shows the results of this exercise. The reader will note that the proposed program would produce a net-cash inflow in each year of operation even under the least favorable forecast.

[Insert Table 1 on separate page]

If this decision had not been further complicated, Mitchell should have gone ahead with the proposed program. At this point no further information would have been required. (Information has value only to the extent that it increases the probability that the best course of action will be chosen. In this instance, each of the three possible states of nature implies the same course of action.)

This decision was, however, further complicated by the fact that the facilities required for the program were not available on campus. At least two buildings would have had to be constructed to accomodate the proposed new programs. It was indicated that the annual cost of the required facilities (interest plus depreciation) would have been nearly $500,000.

When these costs were included in the forecasts, it seemed that under the least favorable state of nature, the net-present value of the proposed program's contribution to overhead was negative (Table 2).

[Insert Table 2 on separate page]

The Value of Perfect Information, or The Cost of Uncertainty

Lacking the means to obtain additional information and assuming risk neutrality, Mitchell, of course, ought to have chosen to go ahead with the

new program as its expected value was $173,000 compared with an expected value of $0 for doing nothing (see Table 2). In this case, however, Mitchell had the option of increasing its knowledge about the reaction of consumers to the proposed programs by means of market research. The question is: how much should Mitchell have been willing to pay for that information?

There is no easy answer to this question. However, it is possible to say categorically that market research expenditures should not exceed the value to Mitchell of *perfect information*, information which would permit the best course of action under certainty, and should approach that level only insofar as additional information resulted in greater certainty as to consumer reaction to the new programs.

The value of perfect information could have been obtained by determining the difference between the net loss that would have been realized on going ahead with the proposed programs and the lesser loss that would have resulted from doing nothing, if consumer reaction to the new programs were unfavorable. This follows from the observation that certain information indicating a favorable consumer reaction to the new programs would have been of no value to Mitchell. This is so because, if it had been known that the consumer reaction would be favorable, Mitchell would have chosen to do what it would have done anyway, go ahead with the new programs. There would have been a cost associated with collecting additional information, but no payoff.[6]

On the other hand, if Mitchell were to have learned that the consumer reaction would be unfavorable, it would not have initiated the proposed programs. This different course of action would have been taken to avoid the loss of $329,800.

However, $329,800 was not the value of perfect information to Mitchell. This loss had to be evaluated before it was known what further information

would reveal about consumer reaction to the new programs. The value to Mitchell of information indicating unfavorable consumer reaction should have taken the probability of that outcome into account. Since the probability of an unfavorable consumer reaction had been estimated to be .25, the expected loss associated with the decision to go ahead with the new programs was $82,500 (see Table 2). Since doing nothing would have involved no loss, the expected opportunity loss associated with going ahead with the programs was, therefore $82,500 ($82,500 - 0). This figure represents the incremental expected monetary value to Mitchell of perfect information. Mitchell should have been unwilling to spend more than this amount for market research.

Nevertheless, as Newman (1971, p. 18) observes:

> The assumption of the availability of perfect information, of course, was unrealistic. Research findings are subject to errors because of the limitations of methods of gathering and analyzing data. Even with error free findings, current knowledge does not permit perfect predictions of the outcomes of future actions.

The maximum that Mitchell should have spent for marketing research was, therefore, less than $82,500. According to Newman (1971, p. 18):

> The exact amount [that should have been spent by Mitchell] depends upon the value of the imperfect information that would be produced by the research.

Using Preposterior Analysis to Evaluate a Market Research Proposal

Unfortunately, one cannot say how much should be spent for market research, all one can say is whether or not the expense associated with a given research proposal can be justified by its likely contribution to decision making.[7] For

purposes of further illustration, a single market research proposal will be discussed. The decision that will be considered is whether to buy market research or to decide on a proposed new program without it. Again, since this decision must be made before the results of the study are known, it is necessary to assign subjective probabilities to the possible outcomes of the research. Then it can be determined whether or not the findings of the study would be worth its cost.

This evaluative process is called *preposterior analysis* and is conducted in a series of steps:

1) List the possible research outcomes and calculate their marginal probabilities.
2) Assume, in turn, that each of the research outcomes has been obtained. For each research outcome:
   a) Revise the prior probabilities.
   b) Calculate the expected payoff of each course of action under consideration and select the act with the highest expected payoff.
   c) Multiply the expected payoff of the best course of action by the marginal probability of the research outcome.
3) Sum the products of step 2c (taken for each research outcome) to get the expected payoff of the strategy that includes ordering research before taking final action.
4) Subtract the cost of the research to get the expected net payoff of the strategy.
5) Compare the expected net payoff of the strategy that includes research with the expected payoff of the strategy of choosing among the alternatives without research.

6) Choose the strategy that maximizes expected net payoff (assuming the use of the decision criterion of maximum expected value). Newman (1971, p. 24).

The Market Research Proposal - At the request of the Mitchell University Planning Committee, the Director of Institutional Planning and Analysis Office (IPAO) prepared a market research proposal designed to determine consumer reaction to the proposed continuing education programs. Under the proposal, information collection and analysis would have required a maximum of 30 days and cost $35,000. Perhaps the study could have been redesigned to reduce its cost, but more time would have been needed and that would have meant delaying implementation of the program for an additional year. It was agreed beforehand that the study should not be allowed to delay the launching of the proposed program.[8]

Nevertheless, before he asked the Planning Committee for approval to begin the study, the Director of the IPAO wanted to assure himself that the information gained would be worth $35,000.

The Director's Analysis - First, the Director identified three categories of study results:

(T_1) results supporting the higher enrollment estimate

(T_2) results supporting the mean enrollment estimate

(T_3) results supporting the low enrollment estimate

Next, he estimated that, if the proposed program were implemented on schedule and if it were to meet with favorable consumer response, the probabilities of observing T_1, T_2, or T_3 in the study were .6, .3, and .1 respectively. Estimates of conditional probabilities of the possible study outcomes were also assigned to the other two possible states of nature (see Table 3).

[Insert Table 3 on separate page]

These conditional probabilities were then multiplied by the prior probabilities to arrive at the joint probabilities associated with each outcome (see Table 4).

[Insert Table 4 on separate page]

Finally, the Director revised his prior probabilities for all the possible outcomes associated with offering the proposed program according to the following formula:

$$P(S_i|T_j) = \frac{P(S_i \cap T_j)}{P(T_j)} \qquad (i, j = 1,2, \ldots)$$

For example:

$$\frac{P(S_1 \cap T_1)}{P(T_1)} = \frac{(.6 \times .25)}{(.15 + .10 + .025)} = \frac{.15}{.375} = .545$$

These revised probabilities were arrayed in the decision tree shown in Figure 1.

[Insert Figure 1 on separate page]

By multiplying the possible outcomes associated with offering the proposed program by the revised probabilities, it was observed that the expected payoff to Mitchell University would be $413,000 if the study found T_1, $200,000 if T_2, and -$85,000 if T_3. Then, to identify the net payoff associated with the decision to carry out the market research proposal, he multiplied the expected payoff of the action that would be taken under each of the possible study outcomes by its probability and summed the products:

$$.275\ (\$413,000) + .425\ (\$200,000) + .30\ (0)^9 = \$198,575$$

Since the difference between this figure and the expected value of offering the program without market research was less than the cost of the study ($198,575 - $35,000 < $173,400), he recommended that the study not be conducted.

Comments

Market planning must deal with a complex, increasingly competitive, uncertain environment. Uncertainty can be reduced by means of market research. But market research is costly. Even if perfect certainty were possible (it is not in most cases), the cost of obtaining perfect information is seldom justified. One of the key questions that must be faced by institutional researchers is: how much information is enough.

This paper describes a decision technique that can be used to increase the likelihood of arriving at good answers to this question. The basic concepts described here are simple and easily understood. Their use does not require a great deal of information or analytical sophistication. However, their use does require a commitment to consistent, systematic thinking and the courage to act on one's professional judgement.

Of course, it is difficult to make the necessary probability judgements about uncertain events. It is difficult to make specific judgements about relative preferences for various outcomes. Furthermore, making good judgements takes practice. Consequently, it is not surprising that administrators frequently choose to substitute data collection for systematic decision analysis or that they use the "need" for additional information as an excuse for avoiding decisions. It is not surprising, but it is unfortunate.

It might also be noted that regulatory and coordinating commissions are particularly prone to substitute data collection for hardheaded analysis - especially where the approval of new programs is at issue - perhaps, because they neither bear the costs of collecting the information or suffer the costs associated with the failure to exploit an existing opportunity. Instead, they require ever greater quantities of information about the likelihood of success before a new program can be approved. In many cases, the information they ask

for should be collected. It is in the institution's best interests to do so. But it should be the institution's responsibility to look out for its interests, not some state bureaucrat's. This assertion does not simply represent my opinion, it is a conclusion that follows from the application of some simple economic tools to the strategic problem faced by North American institutions (see footnote 1). If institutions do face increasing costs, it can be shown that the information requirements that are imposed upon them by state regulation represent a dead-weight economic loss (Thompson 1976, p. 8).

Footnotes

1. These assertions may seem overly strong to some readers. I believe, however, that they are clearly justifiable by the application of some simple economic tools to the strategic problems facing most North American institutions. When talking about demand, economists make a useful distinction between movements along a demand schedule and shifts in demand schedules resulting from changes in underlying demographic forces and consumer tastes. The demand schedule is a function of all the attributes of a product or service including its price. Usually, the product is held constant and the demand schedule is drawn to show the price of the product and the quantity saleable at that price. However, it is quite proper to hold price constant and draw the demand schedule to show the relationship between the quality of the product and the quantity saleable at that quality.

   Given this distinction it is possible to put forward two propositions about institutional cost. First, holding constant the quality of services provided per student and the terms upon which those services are provided (i.e. admission standards, tuition, etc.), if student demand schedules shift outward, marginal costs will decrease as enrollment increases. That is, where C stands for total cost, E for enrollment, D for student demand, S for education services and T for the terms of enrollment:

$$\left.\frac{\partial^2 C}{\partial E^2}\right|_{\substack{S = S_0 \\ T = T_0}} < 0 \qquad (1)$$

   This proposition follows from the observation that, by spreading variable overheads and by more fully exploiting specialization, the division of

labor, and opportunities for factor substitution, an institution can provide the same set of educational services to increasing numbers of students at a decreasing cost.

Second, holding students' demand schedules constant, enrollment can only be increased by reducing the cost or increasing the benefit to the student of enrolling in college. Here, the law of diminishing returns should apply. Consequently, we would propose that, holding student demand schedules constant, an institution's marginal cost increases as enrollment is increased. That is:

$$\left.\frac{\partial^2 C}{\partial E^2}\right|_{\substack{D = D_0 \\ T = T_0}} > 0 \qquad (2)$$

This proposition follows from the observation that an institution can increase enrollments by offering more course titles or degree programs, better training, more stimulating interaction in the classroom or class laboratory, smaller class-size, more times and locations at which courses and degree programs are offered, or better counseling to assist the student in matching his or her interests to the offerings of the institution. These additional services usually cost money and, other things being equal, it can be concluded that an institution can increase enrollment only at an increased cost per student.

Until very recently, student demand schedules were constantly shifting outward. During that period, the first of these two functions likely dominated the second. Institutions could increase enrollment and thereby revenues without concerning themselves about consumer preferences.

Moreover, state-level regulation of entry into the market - a policy that was wholly justified by decreasing marginal costs (proposition 1) - tended to dampen competitive pressures. Consequently, since costs were decreasing, constant per student revenues meant that institutions could afford to pursue such objectives as prestige or campus balance.

Now, however, the demographic forces underlying student demand hold little promise of further outward shifts in student demand schedules. Institutions must, therefore, turn their attention to the management of service attributes if they are to expand, and, as competition increases, to hold their ground.

The structure of this argument is based upon Alchian (1959) and Hirshliefer (1962); its content upon Bower (1973), Kotler (1975), and Dorfman and Steiner (1954); empirical support for the second of the two cost proposition is found in Hoenack (1971) and Bishop (1977); the literature on demand for educational services is summarized in Jackson and Weathersby (1975).

2. Under competition, non-profit organizations must seek to maximize revenue if they are to survive. Given this objective function, unambiguous advice about resource allocation can be provided by the institutional researcher. Assuming an appropriate responsibility structure, revenue maximization implies the following optimal solution to the resource allocation problem:

$$\frac{mr_1}{mc_2} = \frac{mr_2}{mc} = \frac{mr_3}{mc_3} = , \ldots, \frac{mr_n}{mc_n} \qquad (1)$$

$$mr_1 - mc_1 = 0,\ mr_2 - mc_2 = 0,\ \ldots,\ mr_m - mc_m = 0 \qquad (2)$$

and $$\sum_{i=1}^{n} R_i + \sum_{j=1}^{m} R_j \geq \sum_{k=1}^{n} C_i + \sum_{j=1}^{m} C_j + \sum_{k=1}^{p} C_k \qquad (3)$$

where:

mr_i = marginal revenue of revenue center i, e.g. an instructional or research program

mc_i = marginal cost of revenue center i

mr_j = marginal revenue of profit center j, e.g. campus development office

mc_j = marginal cost of profit center j

R_i = total revenue of revenue center i

R_j = total revenue of profit center j

C_i = total cost of revenue center i

C_u = total cost of profit center j

C_k = total cost of cost center k, e.g. campus planning office

Furthermore, (1) and (2) hold across all input combination. While it is not possible to solve this optimizing problem in any real sense, the existence of an optimizing rule should permit rational choice between limited numbers of alternatives and, therefore, should permit the analyst to provide information which is directly relevant to the making of key institutional decisions.

3. Enrollment forecasting is an obvious example of this point. However, most enrollment forecasting continues to limit itself to an estimation of the total market for educational services based upon an analysis of demographic factors. Institutional analysts implicitly assume they will maintain their share of the market. While enrollment forecasting is becoming more sophisticated, i.e. greater attention is given to age-participation models, and it is increasingly recognized that the student market may be

segmented into groups with different propensities to participate in post-secondary education, very little attention has been given to modifying enrollment forecasting models to account for the effects of changes in the width, depth, or breadth of the service mix available to potential students, let alone to modifying these models so as to estimate the size of a given institution's market share as function of its competitive characteristics (Fitz-Roy 1976).

4. The remainder of this paper is based upon Newman (1971, pp. 16-27).

5. The fact pattern in this paper has been adopted from Lundgren (1973).

6. This means that no value is assigned to reassuring decision-makers that they have made the right decision. This evaluation is implied by the assumption of risk neutrality.

7. Here it should be noted that the best alternative accepted can be no better than the best alternative considered. Alternative research proposals should be prepared, given sufficient time and competance, and each relevant alternative should be subjected to the same scrutiny. However, even the most rigorous analysis frequently turns into gross satisficing when confronted with the problem of selecting a research strategy.

8. Note that delay would have been very costly regardless of the actions of potential competitors. At a minimum the expected net contribution of the program would have been deferred for a full year. Using a discount rate of 10 percent the minimum loss would, therefore, have been $17,400. However, in this case there was a possibility that a nearby university might have exploited Mitchell University's indecision by expanding its

extended education programs into the areas contemplated by Mitchell. In that case, the entire $174,000 would have been lost. It was estimated that the probability of this latter outcome was .2. Hence, the expected cost of delay was $48,320 (.8 × $17,300 + .2 × $173,400).

9. Obviously, if the study indicated T_2, the decision would be not to introduce the proposed programs.

I wish to thank William Tetlow, Larry Jones, Sharon Thompson and Herb Moskowitz for helpful comments on this paper.

Table 1

MITCHELL UNIVERSITY

Cash Flow Forecasts
(in thousands)

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6-10
			Low Estimate			
Revenues	$ 819	$ 819	$ 878	$ 890	$ 949	$ 1008
Costs - Fixed	228	228	228	228	228	228
Faculty:						
Management	186	186	186	186	186	186
Teaching	23	23	23	23	23	23
Evening	30	30	30	30	32	35
Total Faculty	239	239	239	239	241	244
Total Operating Costs	467	467	467	467	467	472
Net Contribution to Overheads	$ 352	$ 352	$ 412	$ 423	$ 480	$ 536
			Medium			
Revenues	$ 960	$ 972	$ 1019	$ 1043	$ 1055	$ 1114
Costs - Fixed	228	228	228	228	228	228
Faculty:						
Management	186	186	248	248	248	248
Teaching	23	23	23	23	23	27
Evening	30	32	35	35	37	40
Total Faculty	239	241	306	306	308	315
Total Operating Costs	467	469	534	534	536	543
Net Contribution to Overheads	$ 493	$ 503	$ 485	$ 509	$ 519	$ 571
			High			
Revenues	$ 1055	$ 1079	$ 1126	$ 1150	$ 1197	$ 1209
Costs - Fixed	228	228	228	228	228	228
Faculty:						
Management	248	248	248	248	248	248
Teaching	27	27	27	27	27	27
Evening	32	35	37	40	42	42
Total Faculty	307	310	312	315	317	317
Total Operating Costs	535	538	540	543	545	545
Net Contribution to Overheads	$ 520	$ 541	$ 586	$ 607	$ 652	$ 664

Table 2

MITCHELL UNIVERSITY

Net Present Value[1]
(in thousands)

	P(v)	
Low estimate	.25 (-$329.8)	= -$82.5
Mean estimate	.50 ($161.8)	= $80.9
High estimate	.25 ($700.8)	= $175.0
Expected Net-Present Value of continuing education program		$173.4

[1] NPV based upon 10% discount rate and 10 year programs life.

Table 3

CONDITIONAL PROBABILITIES OF MARKET-RESEARCH RESULTS

	Market Research Results		
	T_1 (high estimate)	T_2 (mean estimate)	T_3 (low estimate)
States of Consumer Reactions to Proposed Programs:			
S_1 (high estimate)	.6	.3	.1
S_2 (mean estimate)	.2	.6	.2
S_3 (low estimate)	.1	.2	.7

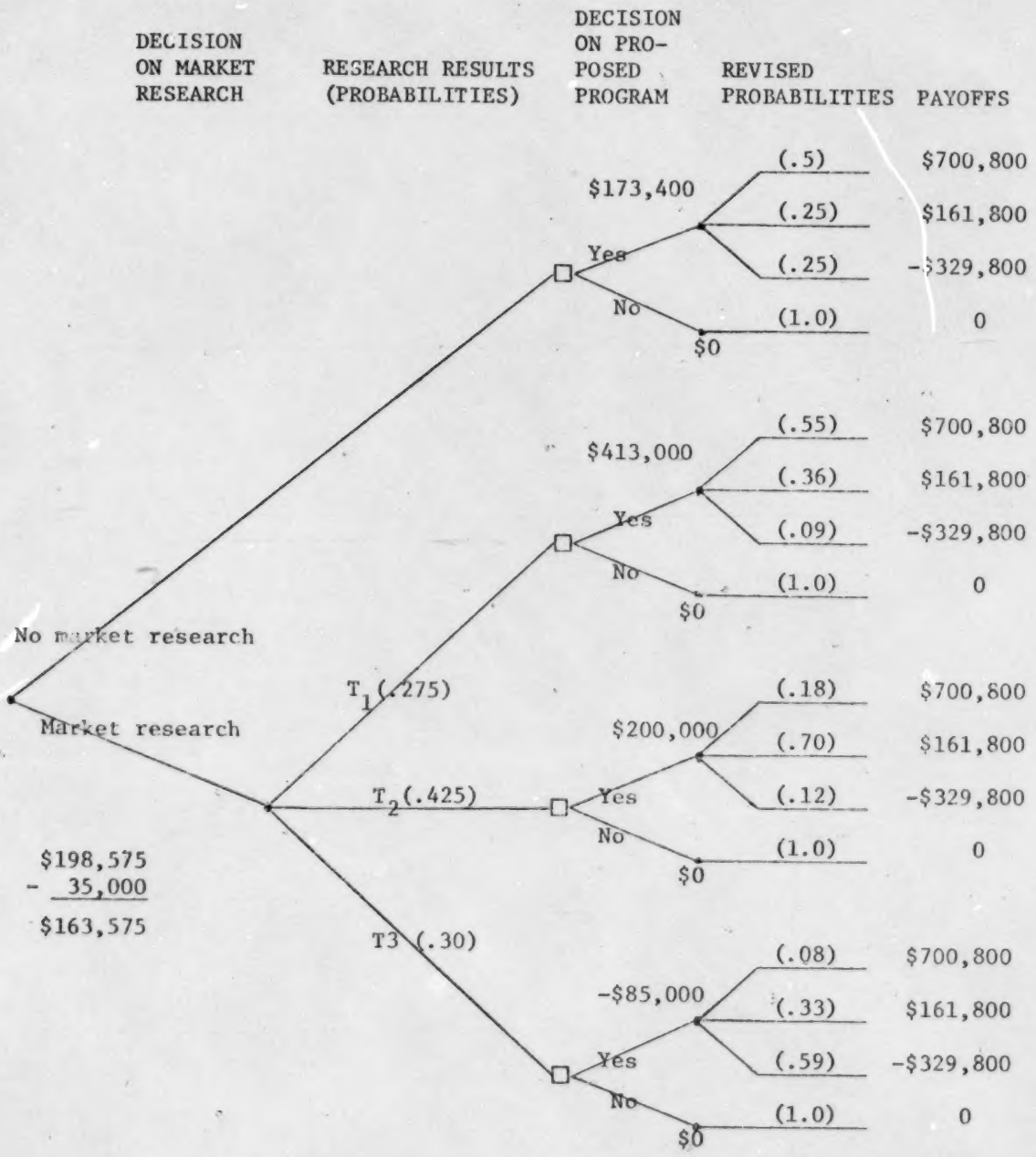
Table 4

JOINT PROBABILITIES OF STATES AND MARKET-RESEARCH RESULTS

	Market Research Results			
	T_1	T_2	T_3	Marginal Probabilities
States of Consumer Reactions to Proposal:				
S_1	.15	.075	.025	.25
S_2	.10	.30	.10	.5
S_3	.025	.05	.175	.25
Marginal Probabilities	.275	.425	.30	1.00

Figure 1

DECISION TREE FOR MITCHELL UNIVERSITY'S PROPOSED CONTINUING EDUCATION PROGRAM: NO MARKET RESEARCH VERSUS MARKET RESEARCH



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